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Analysis, Design and Detailing of Multistorey Building with Economical Sections for Real time Execution

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ABSTRACT:The rapidly developing world, in construction industry software's are used today is the urgent necessity of the moment in order to match the peace of infrastructural development. The main objective of the study is checking the computability of results. The analysis and design of Reinforced Concrete structures is a final stage in the construction industry to deliver the projects with in the estimated time and within the budget. Analysis and design tasks is not an easy matter of fact. Especially specialized software's are used such as Robot structural Analysis, MIDAS Gen, SAP2000, STAAD PRO, ETABS, TEKLA Structural designer, S-Frame and so on. To gain the design results most commonly used software are validated. In manual design process Indian Standard Codes are utilized and different design modules are used to gain the confidence of the users.

KEYWORDS:TEKLA Structural designer,FE Chase Down.

I. INTRODUCTION

The study and design of a multi-specialty hospital building are the focus of this project. The TEKLA software is used to model the hospital building. A powerful but user-friendly special purpose analysis and design programmer created especially for building systems is called TEKLA. A shared database is used to connect the unparalleled modelling, analytical, and design processes included in TEKLA 2022 with its easy and potent graphical user interface. TEKLA is the instrument of choice for structural engineers in the building industry because, despite being quick and simple for simple buildings, it can also manage the largest and most complicated building models, including a wide range of nonlinear behaviour

II. RELATED WORK

Alokkumar A, et.al. [1](2017), The year 2016 was used to create this work, Multistorey RC Building Seismic Design Using Various Codes. Seismic design, which the author discussed, focuses on the yielding and inelastic behaviour of structural elements that are specifically designed to exhibit such behaviour during earthquakes. The structure of the building is strong enough to withstand earthquakes with elasticity.

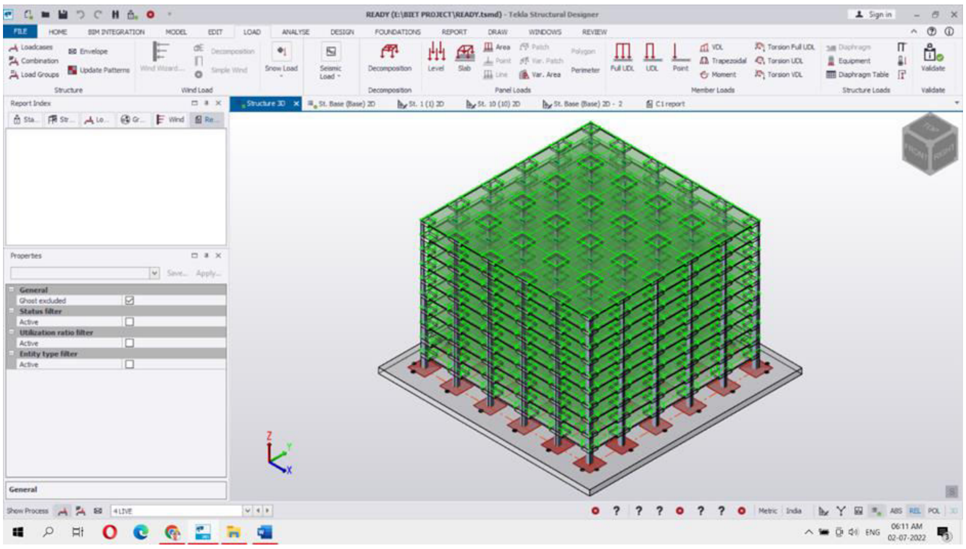
B. R. Jayalekshmi et al. [2](2014), The authors of this paper presented ideas that are widely accepted as being true for earthquake-resistant structures, such as the fact that the ground beneath a building is the primary medium that experiences an earthquake's initial effects before moving on to the foundations that are rooted in the ground.

JontyChoudhary,et.al.[3](2018), The structural components that can withstand a later load must be developed and analysed in advance, according to the author of this research. They are then integrated in high-rise buildings utilising bracing systems, and their analysis is done using E-tabs models.

Ketan Bajaj et.al. [4](2013), According to the author of this study, the behaviour of a structure would change as the kind of soil changes—from hard soil to medium soil to soft soil— According to IS 1893:2000, this study calculates the base shear, storey drift, and later displacement for the various soil strata by taking into account various floor levels, including G+4, G+6, and G+9, as well as various seismic zones, including 2, 3, and 4. 10

III. METHODOLOGY

Step-1: Initial setup of Standard Codes and Country codes.
Step-2: Creation of Grids points &Generation structure. After getting opened with TEKLA we select a new model and a window appears where we had entered the grid dimensions and storey dimensions of our building.
Step-3: Defining of property Here we had first defined material property by selecting define menu material properties. We add a new material for our structural components (beams, columns, slabs) by giving the specified details in defining. After that we define section size by selecting frame sections as shown below & added the required section for beams, columns etc.
Step-4 Assigning of Property After defining property we draw the structural components using command menu. Create a grids for beams and create a columns in region for columns by which property assigning is completed for beams and columns.
Step-5 Assigning of Supports By keeping the selection at the base of the structure and selecting all columns, we assigned supports by going to assign menu joint/frame Restraints (supports) fixed.
Step-6 defining of loads In TEKLA all the load considerations are first defined and then assigned. The loads in TEKLA are defined as using static load cases command in define menu.
Step-7 Assigning of Dead loads After defining all loads. Dead loads are assigned for external walls, internal walls in staad but TEKLA automatically taken care by the software i.e., inbuilt
Step-8 Assigning of Live loads Live loads are assigned for the entire structure including floor finishing.
Step-9 Assigning of wind loads Wind loads are defined and assigned as per IS 875: 1987 PART-3 by giving the wind speed and wind angle. But since this is a G+5 Multi-stored Building and assigning of wind loads or earth quake loads.
Step-10 Assigning of Seismic loads Seismic loads are defined and assigned as per IS 1893:2002 by giving zone, soil type, and response reduction factor in X and Y directions. But since this is a G+10 Multi-stored Building and assigning Seismic loads.
Step-11 Assigning of load combinations Using load combinations command in define menu 1.5 times of dead load and live load will be taken as mentioned in above.
Step-12 Analysis After the completion of all the above steps we have performed the analysis and checked for errors.
Step-13 Design After the completion of analysis we had performed concrete design on the structure as per IS 456:2000. TEKLA performs the design for every structural element.



IV. EXPERIMENTAL RESULTS

Level	Ref.	Stack	Combination Dir 1	$\lambda_{Dir\ 1}$	Combination Dir 2	$\lambda_{Dir\ 2}$	Combination Dir 1/2	Twist
St. 10 (10)	C6	10	2 (Final) LS_2-1.5D+1.5L+1.5Lr	0.512	2 (Final) LS_2-1.5D+1.5L+1.5Lr	0.513	2 (Final) LS_2-1.5D+1.5L+1.5Lr	1.003
St. 10 (10)	C1	10	2 (Final) LS_2-1.5D+1.5L+1.5Lr	0.605	2 (Final) LS_2-1.5D+1.5L+1.5Lr	0.512	2 (Final) LS_2-1.5D+1.5L+1.5Lr	1.004
St. 9 (9)	C6	9	2 (Final) LS_2-1.5D+1.5L+1.5Lr	0.531	2 (Final) LS_2-1.5D+1.5L+1.5Lr	0.531	2 (Final) LS_2-1.5D+1.5L+1.5Lr	1.002
St. 9 (9)	C1	9	2 (Final) LS_2-1.5D+1.5L+1.5Lr	0.621	2 (Final) LS_2-1.5D+1.5L+1.5Lr	0.531	2 (Final) LS_2-1.5D+1.5L+1.5Lr	1.003
St. 8 (8)	C6	8	2 (Final) LS_2-1.5D+1.5L+1.5Lr	0.593	2 (Final) LS_2-1.5D+1.5L+1.5Lr	0.594	2 (Final) LS_2-1.5D+1.5L+1.5Lr	1.001
St. 8 (8)	C1	8	2 (Final) LS_2-1.5D+1.5L+1.5Lr	0.674	2 (Final) LS_2-1.5D+1.5L+1.5Lr	0.593	2 (Final) LS_2-1.5D+1.5L+1.5Lr	1.001
St. 7 (7)	C6	7	2 (Final) LS_2-1.5D+1.5L+1.5Lr	0.734	2 (Final) LS_2-1.5D+1.5L+1.5Lr	0.735	2 (Final) LS_2-1.5D+1.5L+1.5Lr	1.000
St. 7 (7)	C1	7	2 (Final) LS_2-1.5D+1.5L+1.5Lr	0.789	2 (Final) LS_2-1.5D+1.5L+1.5Lr	0.735	2 (Final) LS_2-1.5D+1.5L+1.5Lr	1.000
St. 6 (6)	C6	6	2 (Final) LS_2-1.5D+1.5L+1.5Lr	0.963	2 (Final) LS_2-1.5D+1.5L+1.5Lr	0.963	2 (Final) LS_2-1.5D+1.5L+1.5Lr	1.000
St. 6 (6)	C1	6	2 (Final) LS_2-1.5D+1.5L+1.5Lr	0.981	2 (Final) LS_2-1.5D+1.5L+1.5Lr	0.963	2 (Final) LS_2-1.5D+1.5L+1.5Lr	1.000
St. 5 (5)	C1	5	2 (Final) LS_2-1.5D+1.5L+1.5Lr	1.205	2 (Final) LS_2-1.5D+1.5L+1.5Lr	1.208	1 (Final) LS_1-1.5D	1.000
St. 5 (5)	C31	5	2 (Final) LS_2-1.5D+1.5L+1.5Lr	1.205	2 (Final) LS_2-1.5D+1.5L+1.5Lr	1.204	1 (Final) LS_1-1.5D	1.000
St. 4 (4)	C1	4	2 (Final) LS_2-1.5D+1.5L+1.5Lr	1.472	2 (Final) LS_2-1.5D+1.5L+1.5Lr	1.482	1 (Final) LS_1-1.5D	1.000
St. 4 (4)	C31	4	2 (Final) LS_2-1.5D+1.5L+1.5Lr	1.472	2 (Final) LS_2-1.5D+1.5L+1.5Lr	1.471	1 (Final) LS_1-1.5D	1.000
St. 3 (3)	C1	3	2 (Final) LS_2-1.5D+1.5L+1.5Lr	1.939	2 (Final) LS_2-1.5D+1.5L+1.5Lr	1.958	1 (Final) LS_1-1.5D	1.000
St. 3 (3)	C31	3	2 (Final) LS_2-1.5D+1.5L+1.5Lr	1.939	2 (Final) LS_2-1.5D+1.5L+1.5Lr	1.937	1 (Final) LS_1-1.5D	1.000
St. 2 (2)	C1	2	2 (Final) LS_2-1.5D+1.5L+1.5Lr	2.884	2 (Final) LS_2-1.5D+1.5L+1.5Lr	2.910	1 (Final) LS_1-1.5D	1.000
St. 2 (2)	C31	2	2 (Final) LS_2-1.5D+1.5L+1.5Lr	2.884	2 (Final) LS_2-1.5D+1.5L+1.5Lr	2.882	1 (Final) LS_1-1.5D	1.000
St. 1 (1)	C1	1	2 (Final) LS_2-1.5D+1.5L+1.5Lr	7.493	2 (Final) LS_2-1.5D+1.5L+1.5Lr	7.555	1 (Final) LS_1-1.5D	1.000

Level	Ref.	Stack	Combination Dir 1	$\lambda_{Dir\ 1}$	Combination Dir 2	$\lambda_{Dir\ 2}$	Combination Dir 1/2	Twist
St. 1 (1)	C31	1	2 (Final) LS_2-1.5D+1.5L+1.5Lr	7.493	2 (Final) LS_2-1.5D+1.5L+1.5Lr	7.489	1 (Final) LS_1-1.5D	1.000

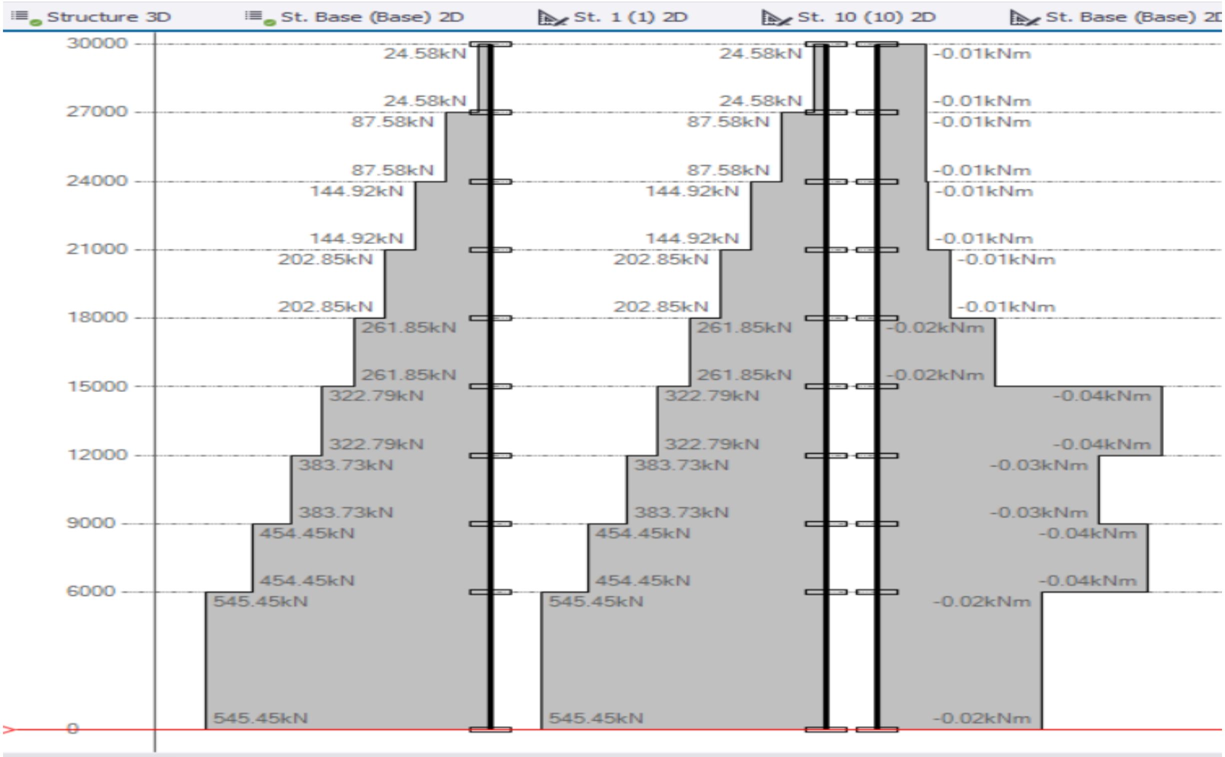
Longitudinal Bars Summary

Stack	Section	Longitudinal Bars	Analysis	Combination	Critical position	Ratio	Status
10	450x450	16T20	FE Chase Down	3 2 (Final) LS_2-1.5D+1.5L+1.5Lr P1 Dir1	Top	**0.827**	✓ Pass
9	450x450	4T20 + 8T16	FE Chase Down	3 2 (Final) LS_2-1.5D+1.5L+1.5Lr P1 Dir1	Bottom	**0.845**	✓ Pass
8	450x450	20T20	FE Chase Down	3 2 (Final) LS_2-1.5D+1.5L+1.5Lr P1 Dir1	Top	**0.540**	✓ Pass
7	500x500	4T25 + 20T20 (12 + 8)	FE Chase Down	3 2 (Final) LS_2-1.5D+1.5L+1.5Lr P1 Dir1	Top	**0.542**	✓ Pass
6	600x600	4T25 + 16T20	FE Chase Down	3 2 (Final) LS_2-1.5D+1.5L+1.5Lr P1 Dir1	Top	**0.442**	✓ Pass
5	800x800	4T25 + 16T20	FE Chase Down	3 2 (Final) LS_2-1.5D+1.5L+1.5Lr P1 Dir1	Top	**0.314**	✓ Pass
4	800x800	4T25 + 12T20	FE Chase Down	3 2 (Final) LS_2-1.5D+1.5L+1.5Lr P1 Dir1	Top	**0.232**	✓ Pass
3	900x900	16T25	FE Chase Down	3 2 (Final) LS_2-1.5D+1.5L+1.5Lr P1 Dir1	Bottom	**0.218**	✓ Pass
2	900x900	16T25	Grillage Chase Down	2 (Final) LS_2-1.5D+1.5L+1.5Lr	Bottom	**0.393**	✓ Pass
1	900x900	40T32 (24 + 16)	FE Chase Down	3 2 (Final) LS_2-1.5D+1.5L+1.5Lr P1 Dir1	Bottom	**0.941**	✓ Pass

Links Summary

Stack	Section	Top support links	Span links	Bottom support links	Analysis	Combination	Ratio	Status
10	450x450	-	2T8-250	-	FE Chase Down	2 (Final) LS_2-1.5D+1.5L+1.5Lr	**0.814**	✓ Pass
9	450x450	-	2T8-250	-	FE Chase Down	3 2 (Final) LS_2-1.5D+1.5L+1.5Lr P1 Dir1	**0.861**	✓ Pass

Stack	Section	Top support links	Span links	Bottom support links	Analysis	Combination	Ratio	Status
8	450x450	-	3T8-250	-	FE Chase Down	2 (Final) LS_2-1.5D+1.5L+1.5Lr	**0.609**	✓ Pass
7	500x500	-	1T8-250	-	FE Chase Down	3 2 (Final) LS_2-1.5D+1.5L+1.5Lr P1 Dir1	**0.535**	✓ Pass
6	600x600	-	3T8-300	-	FE Chase Down	3 2 (Final) LS_2-1.5D+1.5L+1.5Lr P1 Dir1	**0.485**	✓ Pass
5	800x800	-	3T8-300	-	FE Chase Down	3 2 (Final) LS_2-1.5D+1.5L+1.5Lr P1 Dir1	**0.500**	✓ Pass
4	800x800	-	2T8-300	-	FE Chase Down	3 2 (Final) LS_2-1.5D+1.5L+1.5Lr P1 Dir1	**0.404**	✓ Pass
3	900x900	-	2T8-300	-	FE Chase Down	3 2 (Final) LS_2-1.5D+1.5L+1.5Lr P1 Dir1	**0.449**	✓ Pass
2	900x900	-	2T8-300	-	3D Building Analysis	2 (Final) LS_2-1.5D+1.5L+1.5Lr	**0.487**	✓ Pass
1	900x900	3T8-85	3T8-90	3T8-85	FE Chase Down	3 2 (Final) LS_2-1.5D+1.5L+1.5Lr P1 Dir1	**0.408**	✓ Pass



V. CONCLUSION

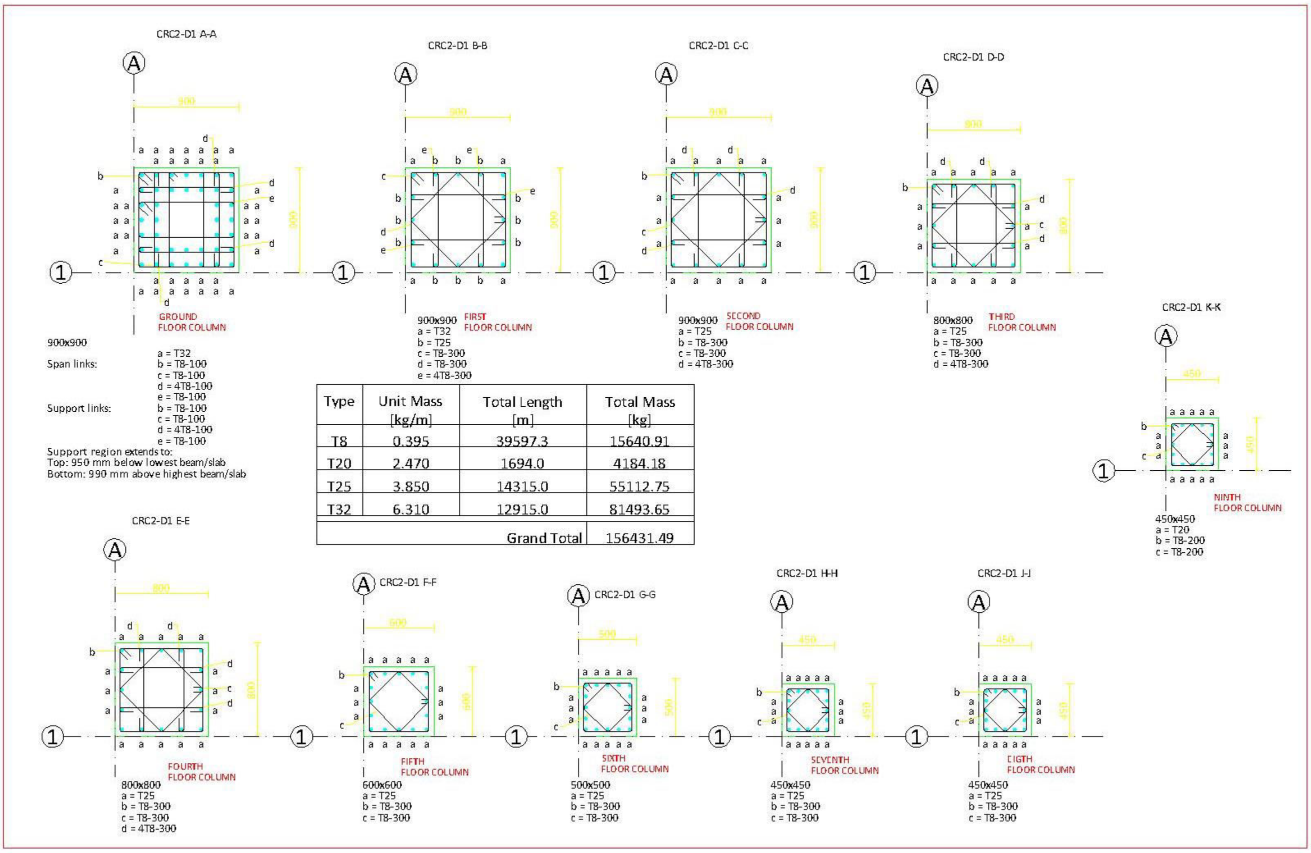
1) Detailed report has been obtained in which the project can be executed Real-time. The footing, slab, column, and beam designs are done in a safe, controllable limit condition. Employing Tekla software, the design considerations have been taken into account for deflection and in all aspects. Following IS Codes. All conditions are safe with the design. Compared to hand design, drawing, and the Tekla-based geometrical model. The Astregion necessary for the slab, footing, column, and beam Comparatively, it is the same as the need While software also provides necessary bar and members, but with a safety factor.

2) Economical section obtained for reducing the cost of construction. Tekla is equipped to figure out how much reinforcement is required for any concrete piece. The programmer includes a variety of parameters that were created in accordance with IS456:2000. Beams are made to flex, shear, and twist. Different types, sizes, and numbers of bars are found from the Tekla result. Additionally, estimate and pricing software validates the final evaluation and valuation.

3) Detailing of reinforcement is done to hence easy to understand and execute. The amount and type of material needed will be reduced as a result of manual and computer calculations. The building falls within the categories of being safe for people and the environment. It is concluded that software is significantly more efficient and reliable than manual labour in the field of designing. It has been observed that the results produced by the software were more effective and economical since they took into account a variety of circumstances under the designing settings that are challenging to take into account when done manually.

4) Tekla structural designer has comprehensive documentation and reporting features, as well as the ability to work with both steel and concrete structures, a Finite Element engine that enables it to perform complex and accurate analyses, the simplicity with which loads can be created and combined into load cases and combinations, automated design features, and the capacity to review analysis results in tekla.

5) The LSM principle, which offers sufficient strength, use, and durability in addition to economy. The variation in displacement, shear force, and bending moment has been demonstrated. If a beam fails, the column's size and the reinforcing details can be modified. 244 International Journal for Modern Trends in Science and Technology.



Type	Unit Mass [kg/m]	Total Length [m]	Total Mass [kg]
T8	0.395	39597.3	15640.91
T20	2.470	1694.0	4184.18
T25	3.850	14315.0	55112.75
T32	6.310	12915.0	81493.65
		Grand Total	156431.49

Column Schedule

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